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SUBJECT: Trip Report - Block II Thermal
Critical Design Review - Case 330

DATE: March 28, 1966

FROM: S. S. Fineblum

ABSTRACT

The purpose of the meeting was to close-out the thermal and Environmental Control System deficiencies identified at the Block II Critical Design Review.

The largest number of ECS items concerned documentation and incorrect or low visibility markings. Performance matters were generally minor variations of performance requirements. The waste management system is being redesigned with no connection into the suit circuit.

Boost temperatures at the SM ECS radiators are excessive and the radiator thickness has been increased. Boost heating may degrade the EPS radiator panels. The need for protection of the SM ECS and EPS radiators against thermal and impingement loads during boost and retro-rocket firing was established. SPS propellant line freezing is a serious problem which may require increased insulation and heaters. Studies on these and other thermal problems are to be complete within five weeks of the review.

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BELLCOMM, INC.

SUBJECT: Trip Report - Block II Thermal
Critical Design Review - Case 330

DATE: March 28, 1966

FROM: S. S. Fineblum

MEMORANDUM FOR FILE

The purpose of the subject meeting was to close-out the thermal and Environmental Control System (ECS) deficiencies identified at the Block II Critical Design Review (CDR). The meeting was held at North American Aviation, Downey, California on March 14-16.

Environmental Control System Meetings

The ECS meetings under the chairmanship of Frank Samonski met separately. The minutes are soon to be available. The largest number of ECS items indicated a lack of, or contradiction in, documentation. The next largest number of Review Item Dispositions (RID's) concerned deficient, incorrect, or low visibility markings. The matters of performance were generally minor variations of performance requirements and specification interpretations. The waste management system is now undefined with the possibility of a more simplified system with no suit circuit loading. The new system, however, requires zero-G experimental verification which is scheduled at Wright-Patterson in the next two or three weeks.

Identification of single-point failures which threaten crew safety was expanded to 14; of these five require off-limit type testing. The current suit circuit O₂/Glycol redundant loop heat exchanger does not conform to specification requirements for cabin precooling to prevent cabin over-temperature during entry. Deletion of the water boiler in the suit circuit in Block II resulted in removal of an independent suit cooling mode which permitted diverting of all normal cooling capacity to precool the cabin. This mode of precooling is required for habitable environment after S/M separation. This RID was left open for further study.

Thermal Problems

Boost temperatures at the SM ECS radiators are excessive (534°F); radiator thickness had to be increased in gauge (and still may require reduction in permissible maximum temperature from ~ 480° down to 420°F).

Effect of boost loads on EPS radiators is complicated by highly mixed flow fields. It appears that boost heating will be excessive and will result in degraded paint and weakened radiator panels. A study is to be completed by April 15. Effects of RCS impingement are to be presented by April 22, 1966.


The gear pump in EPS cooling system may become vapor-locked by overly warm coolant (BP \sim 275°F).

The need for thermal protection against thermal and impingement loads on the SM ECS and EPS radiators during boost and retro-rocket firing is firmly established among working level people. NAA-SID and MSC will jointly propose to the project management a hard (honeycomb-fiberglass) cover which is to be ejected (by action of loaded springs) after retro-rocket firing.

CM RCS thermal studies and tests both indicate that the method of direct coil heating is satisfactory for the valves but marginal for the injector. For the most hot case, maximum electrical load in unpressurized cabin, 120°F is predicted versus 105°F specified. A study is promised by April 22, 1966.

SPS propellant line freezing is a serious problem as 40 watts is lost to space (\sim 75% radiation \sim 25% conduction). Solutions are (a) to keep heat in, (b) add heat, or (c) combine increased insulation with heaters. Of the heating sources, both electrical and radioactive promethium¹⁴⁷ are being considered by NAA-SID. Recommendations are due from NAA-SID by April 15, 1966. MSC requested additional data to verify the NAA statement of need for 10 watt heating.

During boost all SM RCS quads will probably overheat somewhat and the high temperature warning lights will remain on for \sim 70 minutes. No serious damage is expected to result.


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